ANONYMOUS R. T BINGHAM APRIL, 1956

REPORT OF THE

CONFERENCE

ON

WHITE PINE TREE IMPROVEMENT

APRIL 24, 1956

CONCORD, N. H.

ANON.

HELD UNDER THE AUSPICES OF

N. H. FORESTRY AND RECREATION COMMISSION

FOREWORD

Recognizing the importance of Eastern White Pine to the economy of New England and the damage it suffers from disease and insects, an informal conference was called to review efforts to improve this species. Representatives of agencies engaged in research were invited, and the response was most gratifying. The following report consists of an edited transcription of the discussion made by tape recorder. It is hoped that the conference will stimulate interest in the improvement of white pine.

INTRODUCTION

TREE IMPROVEMENT IN EASTERN WHITE PINE

Eastern White Pine (Pinus strobus) is the most important tree in the northeast. It composes 2/3 to 3/4ths of the lumber cut; it is used for boxes, cooperage, wood pulp, excelsior and scores of special products. It seems logical that attention be devoted to improving this excellent tree so well suited to intensive culture in this region.

White pine has two principal enemies: white pine weevil and blister rust. The former is chiefly responsible for poor form in second growth trees and the latter causes high losses in seedlings and considerable loss in merchantable timber. Millions have been spent on Ribes eradication and this protection is a continuing heavy expense.

Selection and breeding work may well concentrate first on developing strains resistant to one or both of these pests. Production of better types having finer or less persistant branches and superior growth are also objectives of a white pine improvement program.

It is recognized that any of these objectives represents a very long-range proposition; not only does the selection and breeding work require an indefinite period, perhaps many decades, but, even assuming success, a great time lag will occur before the improved strains reach merchantable size and begin to influence industry. Seed production or propagation can be accelerated but mass establishment or new strains can occur only by seeding or planting followed by a normal crop rotation before harvest.

However, if any tree improvement is to be attempted, white pine is a good subject for it, not only because of its economic importance, but becuase of its observed variability, e. g. expression of dominance, differences in vigor, etc. Moreover, it is a good seed-producer and is easy to grow and establish by planting.

A very complete program of research in white pine improvement has been undertaken by the Northeastern Forest Experiment Station, U. S. Forest Service, by the Dominion of Canada and by private foundations, universities and individuals. Work on blister rust resistance is especially well coordinated and summarized in annual reports.

It is now proposed to examine these programs by an informal conference and discuss what more, if anything, should be done about white pine improvement.

1. What has been accomplished to date in white pine improvement?
2. What do we know about white pine genetics?
3. What are the present objectives in white pine improvement?
4. Is the present research program adequate to accomplish these objectives?
5. What agencies and individuals are engaged in this program and what is the special field of each?
6. Is there any unproductive duplication?
7. What coordination of research program is there among the different agencies?
8. Is there room for additional cooperation by other agencies?

9. Can the program be improved, accelerated or supplemented by additional workers or funds?
10. Is a large-scale, well-supported program justified?

If the last three questions can be answered in the affirmative by this conference, there are several possibilities that can be explored:

A. The first step may be the preparation of a joint research plan with the part to be played by each agency defined.

B. A comprehensive program can be prepared showing supplementary needs, and support solicited from foundations and from the white pine industry.

C. Provision of some sort should be made for the continuity of a white pine improvement program indefinitely or until results are complete and objectives attained.

If this project is worthwhile, let us raise our sights and outline a really big program if that will get results quicker.

N. H. Forestry and Recreation Commission
Concord, New Hampshire

April 11, 1956.

ATTENDANCE AT CONFERENCE ON WHITE PINE GENETICS

APRIL 24, 1956

N. H. Forestry and Recreation Commission, Concord, N. H.

Harry K. Rogers, Chairman
Owen Johnson, Member of Commission
William H. Messeck, Jr., State Forester
L. E. Newman, State Leader, Blister Rust Control
H. I. Baldwin, Research Forester

University of New Hampshire, Durham, N. H.

Lewis C. Swain, Professor, Department of Forestry
Bertram Husch, " " " "
Harold W. Hocker, " " " "

University of Massachusetts, Amherst, Mass.

Herschel G. Abbott, Professor, Department of Forestry
Donald L. Mader, " " " "

University of State of New York, College of Forestry, Syracuse 10, N. Y.

Ray R. Hirt, Professor
F. U. Klaehn, Student

Society for the Protection of N. H. Forests, Concord, N. H.

Lawrance W. Rathbun, Forester
J. Willcox Brown, Assistant Forester

Ontario Department of Lands and Forests, Maple, Ontario, Canada

C. C. Heimburger

U. S. Forest Service, N. E. Forest Experiment Station

Ernst J. Schreiner, Morris Arboretum, Chestnut Hill, Philadelphia, Pa.
Robert W. Wilson, Jr., Laconia, N. H.
Victor S. Jensen, Laconia, N. H.

Harvard University, Cabot Foundation, Cambridge, Mass.

William Critchfield
Albert G. Johnson

CONFERENCE ON WHITE PINE GENETICS, APRIL 24, 1956

HARRY ROGERS: This is Mr. Owen Johnson, Member of our Forestry Commission.

OWEN JOHNSON: I probably know so little about forestry that I can't understand why after over 45 years or so of logging and lumbering myself, we haven't so far, to my knowledge, made any progress in tree improvement. I have never cut a tree that I think had been improved to a reasonable extent by any act of man. God put them there and we cut them. We raise more corn and better corn and disease-resistant corn and wheat and oats. About everything that we can think of that grows has been improved wonderfully in the last hundred years. We have even improved our methods of logging and manufacturing. I can't understand why we cannot produce a disease-resistant and possibly a faster-growing (more board feet to the acre) white pine tree. I have tried to start something here to see what has been done and can be done, and it possibly can save us a whole lot of wasted effort. Furthermore I think this must be a general effort in all the area that produces white pine. It takes quite a while, I know, to grow a tree. What can we in New Hampshire do to further this, to help and possibly do away with duplication? I want to thank you, gentlemen, for coming.

W. H. MESSECK: I think that sums up our problem pretty well and also the purpose of this meeting. Some of you have come from down South and are probably surprised to see the snow we have on the ground. When I first became State Forester five years ago, I happened to be up in the north country and there an old-timer was telling me a story about a visitor who called at our lookout tower at Third Connecticut Lake. It was August and he met the lookout watchman and asked him what kind of a summer he had had. Third Connecticut Lake incidentally is about 1 mile from the Canadian border. The old fellow looked at him for a minute and scratched his head and said, "Well, I really can't tell you what kind of a summer we've had because I've been drunk both days". That's just about the way this season seems to be going here at the present time. Since Henry Baldwin knows so many of you and has been in this type of work for a good many years, I'm going to appoint Henry as Chairman of the meeting. Now, Henry, why don't you take over now.

BALDWIN: Perhaps the best thing would be to ask the fellow who has been with the forest genetics program probably longer than anyone else here, Ernie Schreiner, to review the work that has been done, the history of the work on white pine. We shall try to limit discussion as far as possible specifically to that one species. Of course, you're bound to get into western white pine or some other related species as it affects the white pine problem in the East. Do you want to say a few words, Ernie?

SCHREINER: Gentlemen, it's a pleasure to be here in spite of the fact that spring is so far behind. I have been in forest genetics research for quite a long time, since 1924. Incidentally, my early work was in New England; I lived at Frye, Maine, long enough to be considered "almost a native".

A review of the work that has been done on the improvement of eastern white pine will not take very long. The earliest work on white pine improvement was on blister rust resistance. I am not certain at the moment as to just when this was started at the University of Wisconsin and at Syracuse, but I think that it is perhaps correct to give the University of Wisconsin credit for the earliest work. I would like to have May Hirt check me on this point.

HIRT: I think we'll take the credit.

SCHREINER: I stand corrected. However, the selection of blister rust resistant individuals was actually the earliest improvement work started with white pine. I will not go further into this aspect because Ray Hirt will probably discuss the history of the blister rust work.

When the Station started its work in genetics in the Northeastern Region in 1936, we gave white pine high priority because of its value in this region. At that time we initiated a limited seed origin test to determine how far out of the region we might go to obtain seed for planting in the Northeast. We obtained three lots of seed in sufficiently large quantities so that the state nurseries could handle the growing and distribution of these stocks of known origin. This seed was distributed to the New York, New Hampshire, and Massachusetts state nurseries. Unfortunately, after three years we were unable to find any record of exactly where this seed had been planted and where the seedlings had been distributed. There have been some additional starts made on seed origin tests with white pine but these will probably be mentioned along with breeding work under way at institutions represented by the gentlemen present at this meeting.

We had hardly made a start on white pine breeding and hybridization at Williamstown, Massachusetts, and New Haven, Connecticut, when the war came along and the Station's genetics project was put on a maintenance basis.

In my opinion, research on blister rust resistance is being adequately taken care of by other organizations; the major problem requiring attention at present is weevil resistance. Several years ago Kriebel carried some work on the selection of weevil resistant trees as part of his graduate work at Yale. Kriebel's data indicated that there might be a correlation between thickness of bark and weevil resistance.

In our genetics research at the Northeastern Station we are interested in rate of growth and also in resistance to white pine blister rust, but during the past three years our major effort on white pine has been directed toward a search for weevil-resistant trees. Discussion of work under way at the present time at our Station, and at some of the other forest experiment stations, is on the agenda, later in this meeting; with the possible exception of the blister rust work, which Ray Hirt can discuss better than I, I don't think the history of white pine improvement merits much additional discussion at this time.

BALDWIN: Thanks, Ernie. Ray Hirt will give us the blister rust resistance history now. I presume you are familiar with reports that the blister rust resistance group gets out every year but perhaps you, Ray, could tell some of the earlier work on it.

HIRT: Well, this comes as a sort of surprise to me. I didn't anticipate discussing this but I'll try to recall from memory some of the earliest observations that I know of. Dr. Heimburger, too, I am sure will have something to say regarding the history of it. Some of the first work on white pine blister rust in this country was done in the Northeast and in New York State. One of the early workers was Dr. Leigh H. Pennington from our own institution who headed the Department of Forest Botany. He did considerable survey work in the Northeast and in New York State started some of the first tests on the relation of weather to the infection of white pine. He established, in 1927, some

plantations of white pine that were exposed to rust under very severe conditions. Dr. Pennington died in the spring of 1929. Prior to his death I happened to be working with him and later took over his work. Every tree which he had exposed to blister rust under known weather conditions and additional trees which I used later were examined two or three times every summer until about 1940 to determine the amount of infection that occurred under specific weather conditions so that we could make comparisons. During the examinations of those pines I noticed as early as 1931 that some of those infected pines had quite well-developed cankers on the stems, but then simply threw off the rust, leaving healed tissue. Some of the trees were about a foot high and had as many as 34 or 35 cankers on them. As far as our information went at that time, if one of those little fellows got a single canker on it, it was sure to die. However, some of those very trees that had as many as 34, 35, 36 cankers on them are still growing and some of them are still infected with the rust. We began to notice that back in 1931, 1932 and 1933. This was our first clue to the fact that some of these trees were rust-resistant or appeared to be. I talked it over with different members of the Office of Blister Rust Control. We began to think in terms of what could we do with those particular trees, what attention should be given them, and how we should go about testing for rust resistance. Later our attention was directed toward the plantations here in New Hampshire that seemed resistant. Mr. Newman and Mr. Boomer were exceedingly kind and cooperative in supplying us with some seeds and some cuttings, so we put some of those under test. A little later, I think about 1937 or '38, Dr. Riker in Wisconsin discovered about the same phenomena of rust resistance. They began their tests in Wisconsin I think about 1937, and were able to devote considerable time to the studies. They have advanced in their work much more rapidly that we have because our primary job at the New York State College of Forestry has been teaching, and this research was something on the side. Dr. Heimburger will speak for himself but he has done some very fine work in his tests on resistance. About 5 or 6 years ago in the west they began making note of the fact that in some areas of heavy infection certain western pines particularly Pinus monticola seemed resistant. They took scions, made grafts and distributed them pretty much through the white pine regions of the East as well as the West for testing. We have some at Syracuse; I know Dr. Heimburger has some in Canada. At the University of Minnesota they are now making some tests on strains of the blister rust fungus. Two years ago they got the first indication that there may be at least two strains of the rust; one of them apparently differs from anything we have here in the Northeast. That fact has not been fully proven but certainly the indications are that there is a difference between these strains but it is very much localized at the present time. Of course, that will complicate our tests in resistance of white pine because we don't know to which of the two strains a tree is resistant.

We are still making new pine selections in our tests at Syracuse. Most of the trees that have been chosen for the first tests were those that indicated resistance. No attention was given to the form of the tree or any relationship to weevilling. Now, however, the selections are being made on the basis of tree growth and tree form. Maybe we will find a rust-resistant tree that may also be resistant in some degree to white pine weevil. I believe that brings the history up to the present time and, while it is very sketchy, it probably touches upon many of the important steps.

BALDWIN: Thank you, Ray Hirt. That was an excellent summary. My plan originally was to have an introductory note on history and then have at least one representative of each organization here tell what their present program is, its status and results and what the future plans are. I think another gentleman from Syracuse has just come in. Would you give us your name, please, so we'll know who you are.

KLAEHN: I am from the Department of Forestry and teaching forest improvement. My home country is Germany and you will pardon my English, I have trouble to speak but I am very glad to come and I hope that it will give me a great deal of information about the problem of blister rust and weevil.

BALDWIN: Thank you. I am very glad to have a representative from Germany because white pine has been planted quite extensively there and, of course, they have a very serious blister rust problem with the cultivated currants. Next I shall call on Dr. Heimburger.

HEIMBURGER: I have an outline and have made an eight-page contribution to this subject. I also gave a paper last summer at the Tree Improvement Conference in Ithaca on my work on blister rust. I think it should have been published but isn't out yet.

SCHREINER: It will be out shortly.

HEIMBURGER: So I have this paper and I'm not going to start off by reading it over again because so many people have already heard it. I can just run over it very briefly. There is one thing in the history which I think should be emphasized. Around 1937, that is, when the work was started on the continent, Dr. Schenck wrote to the Dominion Forest Service in Canada and wanted seeds of different origins. He also wrote to several people in the states. He assembled a large collection of seed samples in Germany and as far as I know they were all lost except some that he sent to Holland to the Dutch Health Society. Not a single strain showed complete resistance but there were some at least that showed a number of plants which were resistant to the rust infection in the humid climate of Holland. Our work in Canada really was stimulated by this letter from Dr. Schenck and we began to collect seed. Dr. Gast at Harvard Forest was doing some work on ecological response of white pine to nutrition and to defoliation and we got some samples from him in exchange for Canadian seed samples. We grew them in our nursery at Petawawa, Chalk River, Ontario. Our most important source came from the plantations in Quebec established at the seignory along the south shore of the St. Lawrence River about 60 miles west of Quebec City where trees were planted in 1908. They were imported from Germany. There were 400 seedlings. They also published a report as soon as they came that they were infected. Of course, the owner told the man to destroy them and he was very troubled. He said he'd taken up the property and said he was going to grow white pine. Our first big plantation is situated in MacArthur which is very favorable for blister rust infection. It is located near a garden growing black currants and so the trees get infected annually and develop very large cankers. When the plantation was examined in 1921, there were 400 plants in the nursery from Germany. The plants were probably of Lake States origin because at that time most of the German seedsmen got their seeds from the Lake States. There were 372 living pines; of these 66% had infection in the initial stage. There are also 20 dead standing trees and 17 of these had been killed by the rust. A single tree could have from 10 to 20 separate infections and one tree had 35 infections. In 1921, there were 50 ribes bushes in the garden from Scotland. In 1941, there were 72 ribes less than 20 ft. from the plantation. In 1948, 46 white pines were left of which one showed an infection of blister rust. The others were free. Since then, 10 trees have had cankers on the stems and one with a branch canker has been located. We asked the owner to remove all trees with blister rust and now we have 35 trees completely free from any sign of blister rust which are over 12 years old, beginning to flower and to produce seed. No new infections have been located and noted in the last

10 years in spite of continuous heavy ribes population. So this is our most important source of seed and it has produced seedlings which are remarkably free from blister rust, not completely free, but they are certainly far less susceptible. The plantation is not yielding uniformly good seed every year because there are some old white pine trees growing nearby of native origin which probably supply pollen. However, we got valuable results from the seed. We have taken scions from 30 to 35 trees and have grafted them and we could not infect them in any manner. They are certainly resistant although when we plant one, the material is not very satisfactory; we have very bushy trees. Now do you want me to read my paper?

BALDWIN: Yes, let's hear it.

HEIMBURGER: I'll read the whole story then you can see what you like about it and pick it to pieces if you want to. READS PAPER AS FOLLOWS:

Pinus strobus is not "the most important forest tree" in Ontario nor in Canada. Some 20 years ago Dr. Gussow stated that white pine is the most valuable tree species in the northern hemisphere, but he meant white pine in general, not particularly Pinus strobus. I find it advisable to deal with the problem in terms of white pine, not in terms of P. strobus only.

The use of white pine wood for pulp is very limited in Canada, the main use is for lumber and yet the lumber industry in Canada is one of the most backward industries, far behind the pulp and paper industry in advanced techniques of wood utilization and in wood production. However, the recent building boom has again forced public attention on white pine and in recent years it is being used very extensively in forest planting, including reforestation in Ontario. This is being done in spite of the fact that the present stock used for this purpose is susceptible to blister rust and weevil injury and that large losses can be anticipated in the future in present-day plantations. Blister rust and weevil resistant trees are not being used at present, nor are any steps being taken to extend their use into the forest beyond a very gradual propagation of nursery stock with the aim of establishing seed orchards and so on according to the Swedish method.

Superior growth is only to a limited extent desirable in white pine. We want good wood producers, not landscape trees, in our work as foresters. The proposition is not as long-range as commonly believed. There are plant physiologists whose usefulness has been demonstrated in other fields of tree-growing and in shortening breeding cycles of trees. "Long-range" is often used as an excuse for lack of achievement, and of current publications summarizing and keeping up-to-date the work in a rather wide field.

White pine lends itself well to breeding work, is easily propagated vegetatively and is one of the easiest tree species to graft. The Government of Canada is currently undertaking research in white pine silviculture, ecology, etc. but not in breeding which is being taken care of by the Ontario Department of Lands and Forests.

Some work is being done by the Canada Department of Agriculture in British Columbia in resistance to blister rust of P. monticola. This is only a very minor project thus far, taking part-time of one man engaged in other forest pathological work as well. The millions expended in protection from blister rust have not all been wasted. We can today benefit from this in having stands

of excellent quality white pine to draw on for breeding materials. It is questionable if this would be possible to the same extent if there had been no ribes eradication since the days of the Great Depression. We have also gained considerable insight into the silviculture of this species and can now produce good stands on certain sites and under certain climatic conditions, with our present growing stock, although this is susceptible to blister rust and weevil damage.

The problem in the Northeast is much more difficult to solve than further inside the continent. It resembles very much the Scotch pine problem in Western Europe. The better growth forms but with slower growth rates are found away from the Atlantic. Near the Atlantic we have poor growth forms and in recent times, greatly accelerated damage from blister rust and weevil. The latter is only in part caused by man. I have seen virgin white pine forests in Nova Scotia since giving my paper at Cornell last August, and I now believe that coastal types have been coarse and limby and weeviled for a very long time, perhaps dating back to pre-Plymouth Rock times. The example of France of 100 years ago when de Vilmorin imported Riga pine seeds should, perhaps, be followed with the present day knowledge of genetic principles added. Continental white pine can be moved to the coast, fungus diseases can be anticipated, weevil damage can be guarded against by proper silvicultural techniques and better consideration of site than has been done previously. Good white pine is a tree of moderately fertile sites. Plus stands and plus trees are essentially hunger types that retain their fine branching, etc. on richer sites because of proper genetic background. We shall strive for dense stands of rather slow-growing trees with fine branches, encourage stayer types in our silviculture and, most important of all, in our breeding work.

Total yield per acre per year is more important than fast growth of individual trees. In 1930, in connection with site classification studies in the Adirondacks, I made a trip to New England with Professor Heiberg of Syracuse University; it was a field trip with his class of students in silviculture. I then saw such weeviled white pine as I never have seen before. But we also saw areas of very good reproduction on old fields, waving in the wind like a field of rye, with weevil damage negligible. The sites were rather poor. These localities should be possible to find again. They must at present carry valuable breeding materials from the standpoint of slender leaders, stayer types, etc. in relation to weevil work. Natural selection in favor of resistance to blister rust has also taken place in the Northeast to a greater extent than anywhere in North America. Trees with large cankers on the main stem are not found as frequently anywhere else as in the Northeast. These trees possess at least partial resistance to blister rust if a polygenic basis of this character is assumed.

I. What Has Been Accomplished.

My paper of last August gives a summary of work on blister rust to date. In addition, much work on weevil resistance, interspecific hybridization and several other phases of breeding work have been accomplished. The work has been in progress since 1937 and has proceeded, although with interruptions and at times with very slender support, until the present time. We now have some knowledge of the possibilities of breeding for resistance to blister rust and weevil damage, as well as about site, general growth performance, climatic adaptation and species crossabilities within white pine. We now have: 1. Several good methods of vegetative propagation; 2. One good method of inoculating seedlings with blister rust; 3. A fairly good idea about species crossabilities

and their importance in relation to blister rust and weevil within the species; 4. A good collection of breeding materials; 5. Experience gained through 19 years breeding and selection work with white pine. All this should provide a valuable background for program expansion and initiation elsewhere. Periodic reports to the USDA give a reasonably good picture of work accomplished to date in respect to breeding for resistance to blister rust, propagation methods and interspecific hybridization. Slender-leader trees have been selected and grafted. Seedlings of slender-leader tree parentage have been raised, inoculated with blister rust and selected for resistance under nursery conditions. Specific tests for resistance to weevil damage have as yet not been made. Weevil resistance, as most other resistance to insects, can be subdivided into two phases. 1. Resistance to attack and 2. Resistance to damage from attack. Slender-leader types of P. strobus possess resistance to weevil attack to a certain degree and under certain conditions of environment but are not resistant to damage from attack. Kriebel's hypothesis of the influence of bark thickness has not been checked in this respect but has some justification. Data have been collected to a limited extent on shoot thickness, using a modified wire gage for this. Several methods of testing white pine for resistance to weevil attack have been thought of from time to time but as yet not carried out, because of other more pressing work. These are:

1. Grafting of scions of slender-leader types into crowns of heavily weeviled open-grown white pine and subjecting these to natural weeviling.

2. Study of oleoresins of several white pine selections with the aim of finding differences in palatability or attractiveness to weevil.

3. Establishing white pine plantations in the vicinity of heavily weeviled older trees and in a locality where weeviling is severe.

4. Use of cages with weevils is not considered advisable in this connection since such a test is believed to be too severe and will probably fail to indicate differences in resistance as compared to the controls.

5. Use of material resistant to damage from weevil attack found in P. monticola and P. peuce in breeding work if such resistance cannot be found within P. strobus. The present 3-station provenance test of P. strobus will be used to survey this situation in more detail. Lack of personnel, especially of technical assistance, will in all probability favor method 3 in the immediate future but the other methods may have useful application elsewhere and at other times.

At present we have about 200 clones of P. strobus that are reasonably resistant to blister rust and within which selection for resistance to weevil attack is in progress. We also have a small P. peuce x strobus F1 generation showing some resistance to damage from weevil attack; it is beginning to flower and can be used for further breeding work. P. monticola offers good possibilities for selection for resistance to blister rust which possibly could be combined with resistance to damage from weevil attack, found in this species. Additional sources for resistance to blister rust are some clones of P. griffithi and P. peuce. P. strobus contains biotypes that can grow in a colder climate than any of the other white pine species and therefore is of major importance to Canada. Current work aims at finding answers to the following questions:

1. How quickly can seedlings be obtained from seeds harvested in the fall?
2. How quickly can seedlings be grown to reach grafting size?

3. On what stocks can the grafted seedlings start flowering as soon as possible?
4. Can a black currant be found that retains its leaves in late summer in spite of heavy infection with Cronartium? Are other inoculation methods possible? such as spring inoculation, etc.
5. Are there any better methods of bagging, pollination, etc. to obtain better seed sets after artificial hybridization?
6. What is the combining capacity and especially resistance transmission of white pine clones selected thus far?
7. What are the most economical methods of mass propagation of white pine by vegetative means?

II. What Do We Know About White Pine Genetics?

No formal genetic studies have as yet been made but several observations indicate inheritance of important characters. P. griffithi has a low stratification requirement for its seeds as compared with P. strobus and the other white pine species have a higher stratification requirement than P. strobus. The low stratification requirement of P. griffithi is partially dominant in crosses with other species. In P. strobus nearly every population sample has seeds that germinate without stratification. This character seems more widespread within Atlantic strains than within strains of continental origin, just as in white spruce, perhaps indicating some kind of climatic selection pressure in respect to this character. Northern strains of P. strobus have smaller seeds than southern but this may be a purely environmental response. Seedlings of P. monticola and P. parviflora grow rather poorly on their own roots with us but do much better when grafted on P. strobus. This may have something to do with their mycorrhizal relationships. Hybrids with P. strobus exhibit no difficulties in this respect. The slow growth of P. peuce seedlings is rather predominant in hybrids with other species. The glabrous shoot of P. peuce is dominant and that of P. griffithi largely recessive in crosses with P. strobus and P. monticola. The odor of green tomatoes in shoots of P. parviflora is dominant in all crosses with other species and is a good marker. The slender leaders (thin shoots) of some P. strobus populations are to a great extent inherited by their seedlings when grown in the same environment as thick-shoot types. The thick shoot of P. peuce and, in part of P. monticola, is inherited in crosses with P. strobus as a partially dominant character. In species crosses within white pine stout wolf types often originate indicating the existence of complementary genes causing this phenotype. This may be very important in relation to weevil resistance work, particularly in respect to resistance to weevil attack. Resistance to blister rust within P. strobus, if there really is a resistance, must be recessive, judging from results obtained thus far. There is strong indication that such resistance is dominant in some P. griffithi. P. monticola retains its needles one year longer than the other species, as a rule. This may be a valuable character contributing to more efficient utilization of solar radiation. It is partially dominant in crosses with P. strobus and P. parviflora. P. griffithi is very susceptible to weevil attack and to damage from weeviling. Unfortunately, this reaction is found in some of its hybrids with other species. The resistance of P. peuce to damage from weevil attack has already been mentioned. It appears to be at least partially dominant in crosses with P. strobus. Strain tests of materials from Ontario indicate the presence of two broad groups, one northern, more or less acidophilous, and one southern, calcium-tolerant. It is quite possible to move northern strains southward, as witnessed by the Schenck plantations near Asheville, N. C.; such results would be unthinkable with northern aspen (poplars). There is probably not much

adaptation to long photoperiods within P. strobus and most native materials are day-neutral in respect to growth. The weevil susceptible splinter types and thin-barked and slender-leader stayer types within P. strobus most probably have a genetic basis, besides being rather strongly influenced by environment. Partial albinism has been found after inbreeding of P. strobus. A P. peuce in Ottawa produced only F1 hybrids with P. strobus when open-pollinated. A P. griffithi in Denmark has produced a great number of self-offspring and a few hybrids, when open-pollinated. P. parviflora is also largely self-compatible. Ontario P. strobus pollinated with Wisconsin pollen gave far more and better seeds than open pollination. This may indicate the presence of S-genes within P. strobus influencing seed set. It would be interesting to study weeviling of New England white pine in relation to the catastrophy theory of H. M. Raup and see if the few localities showing no or weak weeviling have a stand history differing from that of the ordinary weeviled types.

The following species crosses are known thus far:

strobus ⟷ monticola		monticola ⟵ peuce	
strobus ⟷ peuce		monticola ⟵ parviflora	
strobus ⟷ parviflora		monticola ⟵ griffithi	
strobus ⟷ griffithi		peuce parviflora	(unknown)
		parviflora ⟷ griffithi	

III. Present Objectives of White Pine Breeding

Resistance to blister rust and weevil characters leading towards good lumber production; high quality is more important than bd. ft./acre/year.

IV. Is the Research Program Adequate?

Not by a long shot! It would be highly desirable if more workers could contribute towards the solution of the numerous problems presented and to other problems that undoubtedly will arise in the course of more advanced work.

V. Agencies Engaged.

Ontario works chiefly for Ontario conditions. Pulpwood production and Xmas trees are as yet of no importance.

VI. Unproductive Duplication

Not thus far but good planning would be quite desirable and beneficial.

VII. Coordination of Research

No formal arrangements are in force. There is free exchange of breeding materials and information through reports on blister rust work to the USDA.

VIII. Room for Additional Cooperation

Yes, by embracing a wider field within the native range of P. strobus and perhaps of some of the other white pine species.

IX. Can Program be Improved, Accelerated, etc.

Any active and important tree breeding program can be improved and accelerated and this applies to a very large extent to a white pine improvement program.

X. This implies that a large-scale, well-supported program is fully justified.

BALDWIN: Thank you, Dr. Heimburger. Now, Dr. Critchfield, do you want to report on the Cabot Foundation?

CRITCHFIELD: Well, I've been with the Foundation only about 2 months. I think I'll turn this very largely over to Mr. Johnson since I am not especially familiar with white pine.

BALDWIN: I know Dr. Johnson's been working with some of the Mexican species and sources. Perhaps you could tell what the Cabot Foundation has been doing on white pine after Dr. Gast started some work on it.

JOHNSON: Just a few words on what we did do while I was there. I think we didn't accomplish as much as Dr. Heimburger did. Today our principal subject is what we do or do not know about white pine genetics. To begin with we tried to set up a provenance test of the type mentioned and in that we used some of the old Gast material some of which is now growing in Weston, Mass. Primarily we were interested in getting crossability information to see what white pine species could contribute towards the improvement of white pine, if we ought to incorporate them in with white pine material with any hope of betterment to the pines themselves. We tried to cross within the limits of the species we had available and got a fair number. These are most likely covered in Dr. Heimburger's listing. These hybrids have now been established for the most part in the field planting and we hope that as they come along they will contribute something to improving the variability of white pine. White pine as a genetic species is relatively stable if isolated from other white pines for a long period of time, and unlike some of our other eastern pines. In itself it does not have much genetic variability. Hard pines of the south cross frequently among themselves so that they form some kind of a flux from a revolutionary point of view. Our white pine has been pretty well off by itself ever since the recession of pleistocene glaciers, so it has settled down in pretty much of a static population. That does not mean, of course, that there are not varietal differences as Dr. Heimburger mentioned; there is apparently a coastal form and a distinct southern race but they seem to blend one into the other. It is a clinal matter without any sharp differences in population. The introduction of other genes into the population should upset things enough so that over a period of time and several generations, too, you should be able to shake out some of the factors we're looking for; perhaps better weevil resistance, better blister rust resistance. To be sure in these tree genetics combinations you never know just what you will get, but sooner or later you should come up with the thing you're after. As far as the Mexican pines go at the present time they probably have little to contribute to this area, although they do show amazing capacity to provide certain types. Some of the white pines of northwestern Mexico seem to be quite happy around the Arnold Arboretum in Boston. As to what the future program under white pine will be I can only add that certainly a program aimed at improving this highly prized species is certainly well worthwhile. In relation to the weevil problem we did make a number of observations on trees showing apparent resistance, or at least tolerance of the insect in the Arboretum and have made some grafts. They have propagated populations of these trees and set them out in areas that would be subject to natural infestation in the hopes that it may confirm or disprove the idea of tolerance. Since I am no longer with the Cabot Foundation, I cannot speak of its plans, of course.

BALDWIN: Can you tell us anything about the white pine program in the Cabot Foundation now, Dr. Critchfield? Have you any plans for white pine work?

CRITCHFIELD: The Cabot Foundation, as you know, has recently undergone personnel changes and I've just been getting organized. I haven't thought a great deal about white pine until this conference came up. The major part of the field plantings that the Cabot has are in Populus. There are all sorts of other genetic trials for white pine and birch and so on, but the Cabot Foundation at its beginning back in the '30's concentrated pretty heavily on white pine. It's steadily growing away from that, and I really haven't formulated any new approach towards white pine. I would like to call your attention to a recent article in "Science" which was a report on some plantations, two 1-acre provenance tests, which were made in the early '40's. This was simply a progress report on how they were coming along and the general picture in those two plantations was that the local forest seed sources were distinctly more successful than other seed sources and the farther away you got the less successful the plantings were.

BALDWIN: Thank you, Dr. Critchfield. Would somebody like to make a report from the University of Massachusetts? Would you do that Dr. Abbott?

ABBOTT: I don't know if I am in too good a position to report on it actually. I think that there has been very little or almost no work done on resistance to blister rust and weevil. There has been work done on vegetative propagation but I'd rather not say anything about it at this time. I have some comments which I would like to make a little later when the subject is open for discussion.

BALDWIN: Will the University of New Hampshire report now?

HUSCH: My own work in white pine has been principally with the soil-site relationships and not so much in the genetical aspects that have been discussed here. I would like to ask Dr. Hocker to make a few comments on the genetical aspects which I think we are trying to get underway at the present time.

HOCKER: We recently participated in a meeting of the agricultural experiment stations for the northeastern states. The meeting was primarily concerned with forest tree improvement and some genetic implications were brought out at that meeting. Our contribution to this cooperative project will be in the direction of stimulating seed production of white pine.. We feel that with the amount of time and the resources which we have that this might contribute more than any breeding program would at the present time. Also there is as much lack of knowledge, I might say, on the natural reproduction of white pine and the management and handling of white pine stands, as there is in the genetic characteristics of the species. So we feel that we will devote our attention to handling natural stands and leave the genetic research to other organizations.

BALDWIN: Thank you. Now I believe that covers just about everybody except the major contribution which I will ask Ernie to report on: The Northeastern Forest Experiment Station.

SCHREINER: Instead of starting with the improvement of white pine, I would like to start with tree improvement in general for the benefit of any of you who may not be too familiar with this subject. There are two aspects of tree improvement that I have tried to illustrate during the past 20 years by this diagram which many of you have probably seen in print. This indicates the approach through selection of the best trees that Nature can provide, and the creation of improved

types through controlled breeding. Nature's best trees, or the progeny of these best trees, may be used immediately for reforestation. The diagram indicates that as better and better trees are produced it will probably be economically feasible to plant them farther and farther up this "hill of inaccessibility" where at present we consider only natural regeneration economically possible. Up to the present time this approach, the production of better trees for planting, has had relatively little appeal in the Northeastern Region. Silvicultural systems that permit natural regeneration without planting have been most generally favored up to the present time. Genetic improvement by mass selection is possible under a system of natural regeneration. The success of such mass selection depends on recognizing individual trees in the forest which will produce the best progenies. Such trees must be favored and left as the progenitors of each succeeding generation. But the tree as we see it in the forest is the result of the effect of its environment on its inherent potentialities. It is impossible to guess accurately the breeding quality of an individual tree until we have some sound genetic information on the inherent characteristics that are important to the forester and to the sawmill man. It is not only necessary to know that a characteristic is inherited, it is also necessary to know the mode of inheritance, that is, what percentage of the offspring will exhibit the particular characteristic. And this precise information can only be obtained from the controlled breeding work which produces the better trees for planting.

With respect to eastern white pine, I would say first that with an adequate improvement program we can be sure that we can produce better white pines; and we can be equally sure that we are not going to have them tomorrow. The fact that this work does take considerable time is all the more reason for starting immediately; it is certainly not a reason for further delay. Fortunately, white pine is a species which New England landowners are interested in planting. Certainly in the past it has been the most widely planted tree in our region. We should therefore plan for the most rapid and certain approach to maximum improvement of white pine, that is, the creation of better white pines through selection and breeding; this should include, selective breeding within the species, racial crosses to utilize the possibility of racial hybrid vigor, and hybridization between species to produce new types that may be better, more rapid growing, more disease resistant and more insect resistant, than our native species.

What are the most important requirements for improvement? I have already mentioned that we certainly need weevil resistance, we need blister rust resistance, and we want the most rapid-growing white pine with good timber quality, that we can develop. Breeding is practically the only possible approach for obtaining this combination of characteristics in a single clone or strain. The chance that we can find such a tree presently existing in the natural forest is improbable if not impossible, and the possibility of obtaining such strains by mass selection under any system of natural regeneration is equally dim.

The evidence at present indicates that we will have to work with these characteristics one at a time. It will be necessary to obtain individuals that have one of these inherent characteristics and ultimately combine them in a new, improved clone or strain. First we should search for weevil and disease resistance. It is possible that when we have such individuals they may come from sufficiently diverse genetic stocks to give at least some hybrid vigor. If not, and if faster growth-rate is still considered necessary, we will have to bring in greater vigor from still another type. Since white pine is one of our

most rapid growing conifers in this region, a tree that is disease and insect resistant would, in my opinion, have a tremendous demand even though its rate of growth was not any greater than that of the native species.

Timber form is often mentioned as one of the objectives of forest tree improvement. At the moment I would not worry too much about improving the timber form of white pine. It is naturally a tree of good form, if it is not reduced to what Carl Heimburger calls a "cabbage head" by heavy weevil infestation. There are, of course, some white pines with inherently poor form but this characteristic is certainly not dominant in the species. I believe that with proper management a weevil-resistant tree can be made to produce the highest quality timber. With the increasing intensity in forest management that will certainly come with improved trees, if it does not come earlier, I think we can count on proper pruning to produce quality logs. Therefore, we need not worry too much about branchiness and size of branches, at least at the beginning of our improvement program.

Now to summarize our white pine improvement program at the Northeastern Forest Experiment Station. Last year the Station developed an over-all program of research with eastern white pine. I will discuss only our genetics research; Vic Jensen may wish to tell you how white pine management research fits into the genetic improvement work under discussion here.

In past years we have been able to do considerable species hybridization work with the exotic white pines available in the Philadelphia area. (The fact that a Pinus monticola plantation in New York State appears to be considerably less weeviled than the adjacent eastern white pine makes this western species a promising prospect for hybridization with our native white pine.) Some of our interspecific crosses and other breeders both in the United States and Europe, have succeeded, others have failed. These hybridizations have usually been limited to one or a very few individuals of the exotic species. For this reason, the hybridization failures of one breeder should not deter further attempts with different trees. In species hybridization work we should not hesitate to try again the crosses reported to have failed, unless such failure is based on pollinations involving many trees in several different years.

Our breeding work has also included intraspecific crosses between white pines from different regions. In this case we obtain pollen from distant cooperators for use on white pines in the Poconos, the natural white pine nearest our headquarters. Here the objective is to determine whether we can obtain hybrid vigor through these crosses between populations that are geographically widely separated. It will be particularly helpful if we can anticipate the presence or absence of hybrid vigor between crosses of distant genotypes, for example, blister rust-resistant types from the Lake States crossed with weevil-resistant types from the Northeast.

Another aspect of our breeding work is to plan for the development of methods for the mass production of hybrid seed. If promising crosses (both inter and intraspecific) are to have maximum practical value for the production of first generation seed, we must have methods for large-scale production of such seed.

The Northeastern Station has been making a survey of exotic white pine species that may be of value in this region. Among these, Pinus monticola, on the basis of its growth and development in a plantation in New York State, deserves wider tests. Its susceptibility to blister rust is a drawback, but if

it does prove to be more resistant to weevil this lack of disease resistance might not be too serious in the Northeastern Region. So far we have been able to find only individual trees or occasional small plantings of exotics, without replication or information on provenance, and seldom with sufficient information on their establishment and early history. We need to test many promising exotics in plantations throughout this region to determine the natural species of white pines that may have value here.

Three years ago we started working on white pine weevil resistance. This appears to be a more difficult task than the problem of blister rust resistance. Our preliminary effort has been to search for stands in which there is statistical evidence for possible inherent resistance to weeviling. We expect to finish this preliminary aspect this summer and move on to the job of searching for weevil-resistant individuals in the most promising stands.

The next phase of this study will be the selection of apparently resistant individuals, clonal propagation and establishment of clonal plantations for tests of weevil resistance in areas where the weevil population is high. The entomologists may also take some of these vegetatively propagated trees for caging tests if that seems desirable. As a rough estimate, this clonal testing of parent trees may take about 10 years. Since it is not enough to know that the particular parent tree is resistant, we must eventually cross the most promising selections to determine the percentage of their offspring that is also weevil resistant. We also have in mind the possibility that if cheap methods can be developed for vegetatively propagating resistant trees, commercial plantations can be made immediately with the selected clones. Since research on vegetative propagation is under way in several places we are not planning any additional studies in this field.

While these clonal and breeding tests are going on, the resistant phenotypes (the trees that are apparently resistant) will be established in seed orchards for the production of seed for commercial planting. Individuals that show up poorly in the clonal and breeding tests will be removed from these plantations before they reach fruiting age. The establishment of seed orchards could wait until we have the final answers on resistance but this would delay the mass production of seed for commercial use by many years.

Last year we started a range-wide racial study with eastern white pine. The objective of this study is to determine the extent and type of racial variation (if any) in this species, and to learn from what regions we can safely draw seed for plantation use throughout the Northeastern Region. This extensive racial study will include about 30 seed origins. The study is being carried on in cooperation with the Southeastern, the Lake States and the Central States Forest Experiment Stations, and the Ontario Department of Lands and Forests, Division of Research, which is represented here by Carl Heimburger. In the Northeast, the test plantations for this range-wide racial test will be established in about 12 different localities from Maine to West Virginia. One plantation will be established at New Haven, where our entomologists can study weevil resistance in these different seed origins. We do not know at present whether there is, or is not, racial difference in resistance to this insect.

The range-wide study will be supplemented by a more intensive study within the Northeastern Region to determine whether or not we have ecotypes that have developed in response to differences in environment. The first study will include stands in the New England region only. The objective will be to determine whether white pine has developed genetically different populations in

response to local site or environmental conditions. This intensive study will be delayed until we have more information on the classification of eastern white pine sites. When we can clearly recognize differences in site, due to soil, climate or other environmental differences, we will select stands on different sites and test the progenies to determine whether there are inherent differences.

There is much facilitating research necessary in connection with white pine improvement and on this we have made only preliminary progress. This work includes pollen studies (including pollen distribution), stimulation of flowering, etc. Wright's studies indicate that the effective pollination distances of pine pollen, for adequate pollination to produce a good seed crop, is about 150 feet, although occasional pollen grains may travel very long distances. These results have been confirmed by work on spruce in Germany.

Since one of the objectives of this meeting is to point out the possibilities for cooperative studies, I would like to indicate where we would welcome cooperation. In our racial studies we will welcome considerable cooperation in 2 or 3 years for the establishment of test plantations throughout the region. The intensive racial studies within the New England area might be handled on a statewide rather than a regional basis; in cooperation with the various states to determine site-wise genetic variation within a limited geographic range.

We will welcome all the help we can get on our search for weevil-resistant trees from those interested in the search for, and field tests of resistant individuals. This must be more, however, than a mere indication that a tree has escaped weeviling. Cooperation on this aspect will require rather intensive research along much the same lines that we have started at the Northeastern Station. If anyone is interested in cooperation on this project, we will be glad to to into details on the methods used.

In Philadelphia we are in a position to cooperate with breeders who wish limited supplies of pollen of exotic species for hybridization. We located our breeding work at Philadelphia in 1942 because this area is rich in exotic forest trees of blooming age. Philadelphia was the center of botanical interest in Colonial days and this early interest resulted in the planting of a great many exotics on private estates.

There is broad opportunity for cooperation on the testing of exotic white pines in this region. This is something that various states and landowners could undertake. We could be of help on such a cooperative program by arranging for seed of known origin. Seed for tests of exotics should be obtained from collectors who can be trusted to give precise information as to the exact location and type of stand from which the seed was obtained; there is little profit in testing seed of unknown origin.

I believe that about covers our genetics research on white pine at the Northeastern Station. Vic, can you think of anything that I should have covered?

BALDWIN: Thank you, Ernie, for such a fine presentation. Vic, do you have something you want to add to that?

JENSEN: Not too much. Of course, we're interested in white pine but it is not the only species. We'd like to see bigger and better trees, better sugar maple, better sugar content, good growing, bigger and better seed trees or improved

stands of birch and so forth but certainly white pine is right up near the top in our region and as Ernie indicated, we hope this summer to make a start which is essential to the program he outlined and site studies which would include white pine and, of course, we have several experimental forests and we do planting; (admittedly some of them are pretty well forested). It's going to be somewhat of a problem but we have pretty good prospects for what you've got in the way of white pine breeding plots at Williamstown, Mass., now. We hope to work on that phase of it particularly at Williamstown and over in Alfred, Maine, but I certainly think there is plenty of need for additional cooperation in that field.

SCHREINER: I believe cooperation on white pine improvement would be benefited if we had an active member on the Executive Committee of the Northeastern Forest Tree Improvement Conference to represent the N. E. Lumber Manufacturers Association.

O. JOHNSON: I can see what the problem is here in New Hampshire among white pine lumbermen. There are very few that have large stands. There are a thousand and one small owners and it is hard work to get them interested.

SCHREINER: We would like to have someone who is actually appointed by the New England Lumbermen's Association.

BALDWIN: We've got concerns like the N. E. Box Company and some of the Maine companies and Diamond Match Company who should be potential members that might be interested in helping the program. I didn't mention this morning that though our efforts are rather negligible, we do have two blocks of white pine provenance tests on the Vincent State Forest with representations from Virginia and other states besides New Hampshire. They were planted just before the war. No observations have been made on them. You can't see any differences from general observation.

MESSECK: Well, gentlemen, I want to suggest something here for what it's worth. I don't believe you realize just how much value this meeting is proving to us for several reasons and I've been sitting back here listening to all this discussion with the idea of seeing how we fit into the picture. One of the first things, it seems to me, is that the reason this program has been retarded or not got off dead center, so to speak, is because there hasn't been enough interest shown at the state level and individual level. Now I want to make it very clear that we're very much interested in getting this thing off dead center in New Hampshire and we'll do everything we can to do it. I'm speaking of what we can do. To start with we have in this state about 140 state tracts. Take a map of New Hampshire and shoot a load of number 8 shot at it and you'll probably get the distribution all the way from the Massachusetts border right up through. Now we are putting each one of these tracts under management. We're setting up management plans, keeping cost records and so forth and we have some very good foresters working on this; so from that standpoint I think maybe we can help out a little bit in finding what may be isolated stands of different types. Another thing that we have been setting up here in the past three or four years is our nursery and in the development of our nursery we tried to look ahead with the idea of just some of the things that you folks are recommending today, namely, getting into our own seed collecting, seed extracting, using our own seed for our nursery stock, and going one step farther to labelling our beds and endeavoring to fill orders from a given locality with the seed that we collected from that locality. We've reached the point now where we have installed at the nursery a cold storage room in which we are solving the problem of tree

distribution. You see we found that our nursery beds never thawed out in time to permit shipments to the southern part of the state. So we put in this cold storage room and we split our lifting season so that now we pick up approximately half a million trees in the fall and ship from the cold storage room on these early orders to the southern part of the state. We constructed a seed storage room. We haven't used that at all yet. It's our long-range plan. We are hoping some day to get to collecting seed and extract our own seed and store it. Then we shall get out of the market as far as purchasing seeds from outside areas are concerned. Now we've reached about the stage at the present time when I think we can say to New Hampshire woodlot owners that we are anxious to give them the best stock possible. With that thought in mind this idea of going out and collecting our own seed and extracting it and using it ourselves appeals to us a great deal. As far as a small extraction plant is concerned possibly we could work it into the state program. For the time being in order to effect this we'd like to work with any agency such as NEFTIC or any of the others to get the thing started. It might be a smart idea when we get a few of our better areas lined up for the NEFTIC group to come around and certify them as seed source areas. So all in all I think that this comes as a rather timely meeting for us and I want you to understand that if we can work in any way, shape or manner we'll be more than glad to do it.

O. JOHNSON: Could I get into the discussion: Is it a fact that seed from what I'd call a good pine tree will produce better pine trees than seed from a poor tree or from a poor commercial tree?

SCHREINER: The best answer would be: "It's an accepted fact but it's not yet a proved fact." We don't have controlled breeding work, or even one parent progeny tests, to determine the breeding quality of such trees. Many of the open-grown limby pines are probably limby because they were open-grown. But collection of seed from high quality trees can be recommended from an "insurance" standpoint. If we are thinking of quality from the standpoint of clear, knot-free timber, we should remember that this quality can, in eastern white pine, be satisfactorily controlled by proper management methods.

The work in the south has been mentioned here. They are taking seed from the best stands and assuming that they will produce better progeny than seed from a poor stand. That's the best we can do at present, so let's do it. There's nothing to be lost by it. It probably will not be more expensive because collection of seed in well-developed seed stands should be cheaper than collecting from trees with small crowns. Why not set aside some of your very best plantations or natural stands which are about ready to come into flower, 20 - 30 year-old plantations, thin them to produce large crowns and to permit the use of ladder trucks?

O. JOHNSON: How short a time is it from the seed to a tree that does flower and you can see what the results would be. I mean in replanting.

HEIMBURGER: 25 years.

O. JOHNSON: Can you graft and get results that way for forest planting?

HEIMBURGER: You can but, of course, you don't know about the trees.

O. JOHNSON: I remember a good many years ago, there was a man, John Kelly, who was an old-time lumberman. He was the head of the Pejebscott Paper Company for a good many years. I was out in the yard that he had in Davenport, Maine, and

this man was looking over the cut; he had no good words to say, he complained about this and that, the grade wasn't good, the length was short and finally John, whose temper wasn't too easy said, "you know the only trouble with you, you weren't born early enough. You should have told God how to grow these trees" and he mentioned "they should be square instead of round".

ABBOTT: It seems to me that there are a lot of areas where different people could contribute to this forest tree improvement program of white pine. I don't know just what we could do in Massachusetts but we are certainly interested and willing to cooperate in any way we can. Someone, I believe it was Don Mader, mentioned some basic physiological research that would make a definite contribution to this effort and I would think that Ted Kozlowski, who is a tree physiologist and Head of our Botany Department, would be very much interested in getting in on this program. Occasionally we have graduate students who are hungry for such projects. Then it seems to me that one of the things we could be doing where a different type of individual could make a contribution, is the mapping of stands as well as the presence of "plus" trees within these stands. I am sure that someone like myself who spends a good part of his time in the office is not the person to do that. I think it's going to be the fellow who's out in the field. Some of our service foresters, particularly, are in a good position to run into these things. Perhaps some stands on state-owned lands would be rather logical ones to think of as possible source of superior trees. I am much interested in this seed collection business because I appreciate that about 65% of our nurseries in the U. S. now depend for the majority of their seed source on dealers and collectors. I think this is a rather recent trend and I am sure that I know that New England and the Northeast here are certainly not up that high in percentage. Most of our seed is bought from commercial seed companies and God knows where the seed comes from. They sometimes tell you but I question how good they are at it, how honest they are sometimes. And as far as this seed extraction business is concerned, of course, we don't have any seed extraction plant in New England. The New York one up at Saratoga is the nearest one. Perhaps if we had an immediate need for some seed extraction work that Eliason up there would be willing to cooperate with us, and perhaps we could take advantage of that plan. It would seem that if we had one in New Hampshire, a stationary one, that New Hampshire would be a logical place with its modern storage plant that they have and facilities for storing seeds.

BALDWIN: Fortunately, white pine doesn't need as elaborate extraction methods as red pine, for instance. You can get pretty good yields of white pine merely from rather superficial drying in a barn loft and then shaking out the cones. You can get really the bulk of the seed that way without any very elaborate equipment.

SCHREINER: But what about cleaning?

BALDWIN: Cleaning could be arranged with not bulky cleaning equipment to go around to the various drying sites.

SCHREINER: I am not certain that New York is in a position to handle small lots of seed. I would like to ask Dr. Abbott a question. Hasn't your group been doing something with white pine in the radiation field on Long Island? Haven't you had some plants down there?

ABBOTT: I don't know as they consider it failed but I think they soon will probably. They even would like to write the thing off out there.

SCHREINER: I agree that your service foresters would be of much help to us in improvement work, but how can we make the service forester, the fellow in the woods, aware of the possibilities for tree improvement? One way is to encourage and help them (financially) to attend the NEFTIC meetings.

On the question of coordinating forest tree improvement I would like to point out that in the south it is being done by the Southern Forest Tree Improvement Committee. I believe that in the Northeast, NEFTIC is playing the same role. They have done a good job in the south, haven't they, Al?

A. JOHNSON: They certainly brought in plenty of industry and as the outcome of it there has developed these various privately endowed projects now part of the program supported by the pulp industry.

SCHREINER: The West Virginia Pulp and Paper Company has an experiment station in South Carolina and they're carrying on some excellent work.

A. JOHNSON: They have initiated some very worthwhile projects.

BALDWIN: I wonder if one concrete thing that might come about would be a bibliography of publications on white pine genetics in the different branches, let's say weevil resistance and blister rust resistance and other features. You're working on that aren't you, Bob Wilson, a bibliography of white pine. Could you tell us a little bit more about that?

WILSON: I'm working on a bibliography of white pine literature not only regarding blister rust but everything all together. This ought to be published in a year or so. I'm going to be done with it myself in a month, I think, which I hope will be of help in the resistance work but I think more specifically of the job that John Wright has embarked on for one of the genetic associations. I think he's chairman of their literature committee making annual bibliographies of forest genetics literature. He's put out one. I think the second one is ready to go isn't it, Ernie? Well, it's current. In other words it's gone back to 1890 and covers up to 1954 and I hope there will be periodic revisions every 5 or 10 years but John is working on something that will be current. It occurs to me that in this group particularly, currentness is of special value. If things are popping fast, then we've got to keep on top of them. I think we actually need both current and complete lists.

SCHREINER: If I understood your question correctly, Hank, I don't think we need to set up any special committee to work on this. The Sub-Committee on Forest Tree Improvement of the Division of Silviculture of the Society plans to get out a forest genetics bibliography each year.

BALDWIN: I was thinking of white pine.

SCHREINER: Anything that is published on the improvement of white pine will be included. I think that with Wilson's bibliography and the current work of the Society Committee, this field will be well covered.

O. JOHNSON: If we can get anything more than a possible group to head up the type of work we've been talking about, programming it properly so that it can be most effective, and beyond that, create more of an interest in this type of work we will accomplish something out of this meeting.

JENSEN: Do you think, Owen, that the Lumbermen's Association interest can be enlisted in a very general way, or are you planning to get an expression of general interest by the members as a whole, is that it?

O. JOHNSON: I think it might be created. I think it's there but I don't think it's been brought out. It's growing quite rapidly.

JENSEN: I wondered if it had reached any point where there was really a marked enthusiasm for it.

O. JOHNSON: Of course, they have never done any part of the work that the pulp people have. The pulp people make money and the lumbermen don't.

BALDWIN: If they begin to hear about industry's support in the south, wouldn't it be logical that they might gradually, in the conservative New England fashion, generate such interest. You have to get it presented to the lumbermen. Another thought would be that if we could show that we could really accomplish something, there are sources of funds from foundations and other groups in New England that could be called upon to support the program. We'd have to have a pretty good case. How much more could be done, Ernie, if the white pine genetics program had more financial support?

SCHREINER: We could expand search on weevil resistance on a cooperative but uniform program so that we would have coordinated work going on in several localities in the Northeast. Now we have about 4 man months a year to devote to that particular job. If we could put 15 to 20 man months on it, we'd get along so much faster. We could also start some of the basic research we've mentioned on the various problems connected with inheritance studies, reproduction and seed orchards.

HIRT: May I have a word. I'd like to point out that there certainly are many opportunities in educational institutions where if more monies were available, considerably more research could be done. For instance, in our own New York State College of Forestry at the moment, we have a couple of our faculty in our own department who are concerned with the variation in decay of white pine caused by the red rot fungus. They hope to discover if certain trees are more susceptible to the attack of that fungus than others. But who's doing the work? Two of our own faculty members. Why? Because we do not have the money in the Department with which to employ graduate students who might undertake such a project as part of the requirement for a doctors degree. We are also interested in the fact that there seems to be a relationship between red rot and weeviling. Such a study would contribute greatly to our knowledge of the genetics of white pine. But again we're limited by the lack of funds. The state has a certain budget for research and that's that. If industry were concerned enough to set up a fellowship or two in these institutions, I think that they could profit by the information they get, and at the same time be turning out good research foresters interested in the genetics of eastern white pine.

BALDWIN: For instance, if you had a physiological problem that you wanted solved, couldn't you ask Boyce Thompson Institute to work on it? In other words there wouldn't be a question of asking anybody for additional money. We might ask Syracuse if there wasn't somebody who could work on this problem. Now that's where your steering committee could help.

SCHREINER: I would like to suggest the possibility of a NEFTIC Committee on improvement of white pine. If such a committee represented each of the interested states and organizations, it could combine interests and ideas. Such a committee, it seems to me, could get the support needed. They could then assign financial aid to the organizations best fitted to handle particular jobs necessary for improvement of white pine. We have a lot of interest all the way from Maine to West Virginia. Why not take advantage of a "going" organization? There is a place for a white pine committee in NEFTIC if you want it.

BALDWIN: Make it clear you refer to the Northeastern Forest Tree Improvement Conference already set up, not the Northeastern Station. It's the Northeastern Tree Improvement Conference that Ernie's talking about. I wanted to make sure that everybody understood.

O. JOHNSON: It isn't the federal government?

SCHREINER: No, but the federal government is represented. The Forest Service has one man on the Executive Committee.

A. JOHNSON: I'd like to ask a question. This is a good idea. What kind of a problem, just what is the seed requirement here in New England in any particular state, that is, what is your gunning point in the future? Just how much of a problem would you have in that field and how much planting can be expected in the future on the part of the lumber industry or other people interested in planting trees. I'm just thinking of that in connection with the vast amount of seed that they use in the south and wondering if it would be anything like that here.

BALDWIN: I think it can be shown that white pine has been the most widely planted of any species in the Northeast. Just what the seed requirement is now I don't know. Maybe somebody here does. Could anybody answer Mr. Johnson's question?

SCHREINER: I don't think the future demand can be measured by present planting. When we have certified seed or improved types, the demand for planting stock will probably mushroom.

JENSEN: I was in Portland last week at a meeting on the possibility of planting burns. It was estimated, a very offhand estimate, that there are about 40,000 acres of the southwestern Maine burn and at 1,000 trees per acre it would take 40 million trees to plant them. The State Forester pointed out that any such program like that was nothing you could do in a matter of a few years. The state nursery in Maine has a capacity of 750,000 a year. What kind of trees would be planted and so on I don't know but people are thinking in terms of planting--

SCHREINER: If the State of Maine set aside some certified seed stands and began to talk about them I believe the demand, even in Maine, would require large nursery expansion.

ROGERS: If this soil bank idea goes through, is it possible that would be the answer?

CRITCHFIELD: I just wanted to ask who at the present time plants white pine? Who are the chief consumers of this species?

BALDWIN: In New Hampshire it's to some extent the water companies in cities and towns and then a miscellaneous lot of private owners, a great many different owners, farmers, 4-H Clubs. Have you got any suggestions on that, Len?

ABBOTT: There has been quite a shift from white pine and certainly it's not the No. 1 ranking species that is being planted, and I think this is largely due to the fact that the bulk of the planting in the Northeast is for Christmas trees. I forget what rank white pine has in the Northeast and it depends on whether you figure in New York or just take in New England. We are raising only about 5 million trees in the six New England States and white pine ranks something like 4th or 5th. It certainly is not a very popular species and it's not popular, I think, because of the weevil and the fact that so much of our planting is for Christmas tree purposes. A good percentage of the seed is probably obtained from New York State. Certainly relatively small amount is collected locally. I would like to say this; it would seem to me that we ought to get the word out to more people and one way we might do it would be a follow-up of the theme at the SAF meeting in Boston this past winter and that was "forest planting in New England". We might use a little infouence to have the theme for next winter's meeting, "forest tree improvement in New England".

SCHREINER: Haven't you had such a meeting?

BALDWIN: No, there's never been one in the New England Section.

SCHREINER: The New York Section had such a meeting a year ago. The Alleghany Section it seems to me had one sometime ago.

ABBOTT: I think most of us here feel it would be a good theme for the program. Perhaps there are some people here who could influence the program committee so that we could have it as a theme. I don't know who is responsible for the program this next year.

BALDWIN: I think it would be a good thing to follow after the planting program they had this year.

HOCKER: To get back to what Dr. Schreiner was saying a while ago about the Northeastern Forest Tree Improvement Conference. I think that any committee that should evolve from this meeting today could very well fit in and I would like to second his suggestion that it would fit in very nicely with theirs. I am a member of the Committee of the Northeastern States Agricultural Experiment Stations and I regretted somewhat that this was set up as a separate organization. We are committed to tree improvement as I said before, but I myself regretted that we had to set this up as a separate organization. I feel very strongly that one organization such as the N. E. Forest Tree Improvement Conference should be able to accommodate any such special interest and keep the number of organizations down to a minimum, but still keep it flexible enough that they could all function. I think many people up here today could probably attend a meeting and I don't think it would be impossible that they could also accept some responsibility as committee members for white pine.

SCHREINER: The question of including Agricultural Experiment Stations was brought up at our NEFTIC meeting last year. Bill Bramble of the Pennsylvania State University was appointed as a committee of one to look into the possibilities of inviting the Northeastern Experiment Station Directors to appoint a member to our Executive Committee. (Since this meeting in Concord, Dr. I. C. Hout, Director of the Maryland Agricultural Experiment Station, has been

appointed, and accepted, membership on the Executive Committee of NEFTIC, to represent the State Agricultural Experiment Stations.)

WILSON: I'm wondering if I can pick up a little information. I've heard about but have never been able to find out much about the white pine committee in New England of which I believe Prof. Holdsworth was Chairman for some years and I think was an outgrowth of the N. E. Council. What does that do, what was it supposed to do and what has happened to it? Would that fit into this thing at all?

BALDWIN: That was the white pine weevil committee of the New England Council, wasn't it?

ABBOTT: I don't know. I do know that they have done some work up there. I don't know anything about this committee although I believe I've heard that Prof. Holdsworth was on it but I mentioned earlier that we have not done much towards forest tree improvement. I know that at the University, Bill Doran has been doing a lot on vegetative propagation of cuttings and Prof. Holdsworth has cooperated with him. They have taken cuttings from some of our superior looking white pines and have had limited success in propagating these cuttings. I don't know anything about this white pine weevil committee although I have heard of it. I am sorry that Prof. Holdsworth is not here to say something about it.

JENSEN: I think that was organized primarily to pressure the entomologists into evaluations of the damage resulting from weevil to the lumber industry and Harold Shepard of the Federal Reserve Bank I think was on the New England Council when that was initiated.

BALDWIN: Yes, they had a large meeting at Amherst about 5 or 6 years ago and Bob Holdsworth was the Chairman of the White Pine Weevil Committee of the New England Council.

ABBOTT: Well, they've done quite a little work on the white pine weevil on controls and the use of sprays and we've had one honor student working on the effect--

JENSEN: I don't know whether it got beyond that because I remember that committee was devoted very largely to weevil rather than to white pine. I can't remember the name of the committee but it was the White Pine Committee, it was on weevil.

ABBOTT: It was on weevil more than any other thing.

JENSEN: And whether it's dissolved or not I don't have any idea. I haven't heard anything about it.

WILSON: The reason I brought this up was that I wonder if we want a committee on white pine improvement or white pine genetics or whether you want one simply on white pine. It has been amply demonstrated here that progress in genetics is tied in closely with progress in entomology of the weevil, pathology and tree-site relationships; all these things are going to enter into any genetics studies and if such a committee is formed, I think that ought to be taken into consideration.

SCHREINER: There is one difficulty with committees. If they get too big and cover too much ground, they may eventually accomplish very little. I see no reason why you couldn't have an overall white pine committee, but wouldn't it be advisable then to have a sub-committee to look into this special aspect of genetic improvement. Such a committee could very well work with NEFTIC. You would certainly be missing a good bet if you didn't take advantage of the technical knowledge available in NEFTIC. I agree with you that improvement in the sense you're using it certainly includes management. But in the sense of this meeting today I thought we were talking more or less of genetic improvement rather than more intensive management methods. Nevertheless I agree that the earliest solution for clean stems is to put the silviculturists to work to develop more intensive management methods.

WILSON: I did want to point out that there is more to improving the white pine than just genetics as has already been brought out here.

ROGERS: Well things are going so fast here this afternoon it won't be long before we get through here without accomplishing something and having that in mind I have thought that we might set up a small committee here to correlate the work we've done and act as a sort of spark plug on getting your group rolling. Perhaps you might come up with something in the final analysis.

BALDWIN: Dr. Abbott suggested that we might get an expression of opinion here as to whether we'd like to have a program on forest tree improvement at the New England Section of the Society of American Foresters meeting next year in Boston and if we got a favorable expression here, we might use that as a means of memoralizing the Executive Committee or whoever makes up the program. Does anyone want to make a motion of that sort?

JENSEN: The only thing that I wonder about is what some of the fellows from the north country think about planting white pine. I think that is out of their field this year and if there's emphasis on tree improvement with white pine as a favorite child that might be unpopular. It is overdoing it a little to have two programs in succession of that type. I feel that if it is something to do with spruce-fir or the industrial angle of forestry, it might be more acceptable.

SCHREINER: I think if you made this a program on tree improvement without specifically limiting it to white pine, you might be surprised by the interest in the north country. The 1958 NEFTIC meeting will be held in Orono, Maine.

BALDWIN: I think that a motion should be worded as tree improvement. We wouldn't necessarily mention white pine specifically and as it has been brought out that management is important, it could be worked into spruce-fir management or any other type of management work, too.

WILSON: I think it's in order for this group to suggest to the Society's Executive Committee that we have a tree improvement program next year. They still have the choice of not having it and I so move.

SCHREINER: I'd like to suggest, since this interest in genetics seems to be quite recent, at least in the spruce-fir region, that you contact Ed Giddings who has been interested in NEFTIC since its beginning.

BALDWIN: We might capitalize on the interest that Ernie's stirred up there if we brought this up now.

WILSON: We might say that in view of the rapidly increasing interest throughout New England in tree improvement we suggest next winter's program be along that line.

SCHREINER: You might even say in view of the interest demonstrated at the Eastern Maine Forum.

WILSON: I think we could write that in a letter transmitting it.

ABBOTT: That's the type of meeting where all the service foresters attend and some of the fellows that are back in the woods and in a position, I think, to recognize some of these superior stands of trees.

SWAIN: There's a question I have in mind here. Are we so organized that we can instruct our chairman to make these inquiries? If we're not, I think we ought to be.

BALDWIN: What inquiries did you have in mind, Lewis?

SWAIN: About inquiring as to whether or not we can get the section to consider this at their meeting.

BALDWIN: This is an informal group with no particular standing but we could address a letter reporting the meeting here and that the concensus was that we would like to make this suggestion and point out the Eastern Maine Forestry Forum is another straw in the wind. It wouldn't do any harm certainly.

NOTE: The rest of the meeting was occupied by a prolonged discussion of what type of organization would be most desirable. Meeting adjourned at 5:00 P. M.